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Mental Health Status and Related Factors of Citizens 6 Months after Mass Death and Injury Due to Crowd Crush Incident: Focused on the Itaewon Disaster in 2022

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Original Research

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Abstract

Objective: Crowd crush disasters result in psychological risks such as anxiety, depression, and post-traumatic stress disorder (PTSD). This descriptive research study identified the mental health status of Koreans after the Itaewon crowd crush disaster and explored related factors.

Methods: Data were collected May 2-9, 2023 using an online survey. Participants included 205 adults aged 19-69 years recruited through South Korean local and online university communities. Their mental health and related factors were measured at 6 months post-disaster. Data were analyzed using IBM® SPSS® Statistics 26.0. and R 3.4.2.

Results: Significant differences in anxiety, depression, and PTSD among participants who experienced the disaster as victims; changes in drinking frequency and alcohol consumption; and differences in anxiety and PTSD according to family type were observed. Comparing the 3 and 6 month surveys, there were no significant changes in anxiety, depression, PTSD, general mental health, or mental well-being. When mental health severity was divided according to victimization, a significant difference in the severity of anxiety, depression, and PTSD was observed.

Conclusions: Participants' levels of anxiety, depression, and PTSD varied according to their direct and indirect experience of the disaster, with higher levels of PTSD even without direct experience with the disaster.

A crowd crush is characterized by a crowd's density and motion, often in a confined space, in which people cannot control their movements. They can be deadly, and the dangers of crowd crushes have been steadily increasing.[1,2] Crowd crush incidents are psychological disasters that cause personal distress and can occur anywhere people gather without malicious intent.[3]

On October 29, 2022, a crowd crush incident, the Itaewon disaster, occurred in a narrow downhill chaotic alley approximately 40 m long and 3.2-4 meters wide near the Itaewon Station in Seoul, Republic of Korea.[4] With 159 deaths and 195 injuries, the Itaewon disaster was the deadliest of 32 crowd-related accidents worldwide between 2018 and 2022.[5] On the day of the Itaewon disaster, videos and photos from the scene were disseminated through social media, and victims and survivors were subjected to insults and criticism simply for being present at the Halloween-themed event.[6] Approximately 40 days after the disaster, a high school student who was a survivor of the Itaewon disaster committed suicide due to trauma and malicious comments on social media.[7] Reckless media exposure lacking gatekeepers was enough to cause indirect trauma.

Although the physical injuries of disaster survivors can be treated immediately, mental health issues that do not appear on the surface are often overlooked, making mental health identification of disaster-affected populations essential.[8] Disasters have a negative impact on mental health by causing anxiety, depression, and post-traumatic stress disorder (PTSD) in communities, and victims of man-made disasters have a higher prevalence of PTSD than victims of natural disasters.[9] According to the *Diagnostic and Statistical Manual 5th edition* (DSM-5), PTSD can be acute or chronic, and may resolve after 3 months, but symptoms may not appear for as long as 6 months or even years.[10] Reifels, Mills, and Dückers, et al.[11] found that exposure to man-made disasters was associated with a 2.27 times (1.36-3.79) higher lifetime risk (odd ratios [OR], 95% CI) for PTSD.

Experiencing a disaster can result in lifestyle changes that can significantly impact mental health if recovery is delayed.[12] Individuals exposed to man-made disasters had a 2.29 times (1.36-3.79) higher lifetime risk (OR, 95% CI) for alcohol abuse disorder, and alcohol abuse disorder had the highest prevalence of post-disaster disorders.[11] Additionally, family interactions during recovery are important in mediating the disaster trauma felt by family members and in processing negative emotions.[13] In addition, the quality of life of for people who have experienced a disaster can vary by family type, with those living alone having a lower quality of life compared to those

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living with others, and resilience also shows significant differences.[14] The results support research suggesting that family type can determine whether psychological support resources are available.[15] Therefore, checking the drinking behavior and family types of disaster victims is essential to ensure successful recovery.

Media exposure to disasters can also cause trauma.[16,17,18] A study related to the Sewol ferry disaster in Korea, another man-made disaster caused by human error and inadequate response similar to the Itaewon disaster, measured indirect trauma in individuals unrelated to the disaster, and found that 57.5% of the 346 participants were at high risk for PTSD and experienced emotions such as sadness, anger, and depression.[19] Moreover, the trauma caused by a disaster requires early identification and treatment, because it leaves sequelae of major depression and PTSD that increase distress and dysfunction.[20] Therefore, mental health assessment of all victims directly and indirectly affected by a disaster is essential for a successful return to normal life after a disaster.

According to a recent study, mental health effects after a disaster can be a delayed response, with psychological trauma not fully manifesting until 6 months after the event.[21]

Furthermore, psychological trauma has been found to be more persistent in the case of man-made disasters.[22] Nevertheless, there is limited research on the mental health of individuals over time following a disaster, and even less on indirect trauma. Therefore, this study aims to assess the mental health status of individuals directly and indirectly exposed to the Itaewon disaster 6 months after the disaster, and to identify mental health outcomes according to subjective victimization experience and lifestyle.

Methods

Participants

Participants in this study were adults aged 19 to 69 with awareness of the Itaewon disaster, recruited through regional community sites and university student platforms in Korea. These channels were chosen to obtain a diverse sample with varying demographic backgrounds, including the general adult population and younger adults who are more active online. Of the 301 individuals who participated in a mental health study conducted 3 months after the Itaewon disaster, a total of 205 (response rate of 68.1%) completed the survey for this study, conducted 6 months after the disaster. All participants understood the study's purpose and voluntarily consented to participate.

Measurements

Anxiety

The Korean version of the Generalized Anxiety Disorder 7 (K-GAD-7), developed by Spitzer, Kroenke, and Williams, et al.[23] and validated by Seo and Park,[24] was used to measure participants' anxiety levels. It is a 7-item, 4-point Likert scale with higher total scores indicating more severe anxiety symptoms and greater functional impairment. The representative question was "I feel nervous, anxious, or impatient," and the reliability of this research tool was Cronbach α = .89. In this study, the reliability was confirmed to be Cronbach α = .92.

Depression

The Patient Health Questionnaire-9 (PHQ-9) developed by Kroenke, Spitzer, and Williams, et al.[25] and validated by Park, Choi, and Choi, et al.[26] was used to determine the level of depression in participants. Nine items aligning with the diagnostic criteria for depressive disorders, such as "feeling low, depressed, or hopeless," were identified on a 4-point Likert scale. The total score was 27 points, ranging from 0-4 (not depressed), 5-9 (mildly depressed), 10-19 (moderately depressed) and 20-27 (severely depressed). The reliability of the questionnaire was Cronbach α = .84, and in this study, the reliability was found to be Cronbach α = .90.

PTSD

The Korean version of the Impact of Event Scale-Revised (IES-R-K), adapted and standardized by Eun, Kwon, and Lee, et al.[27] from the Impact of Event Scale Revised (1997),[28] was used to measure participants' PTSD. The instrument consists of 22 items scored on a 5-point Likert scale ranging from 0 to 88. The higher the score, the more severe the post-traumatic stress. In this scale, 0-17 points was considered normal, 18-24 points was considered risk, and 25 points or more was considered high risk. Representative items included "Reminders of the event brought back the feelings I had at the time" and "I tried not to think about the event." In a study by Eun, Kwon, and Lee, et al.,[27] Cronbach α value was found to be .83, and in this study, the reliability was found to be Cronbach α = .96.

General mental health

The General Health Questionnaire (GHQ) developed by Goldberg[29] and standardized into Korean by Shin[30] was used to measure participants' general mental health. A higher total score indicates lower mental health. The reliability of the questionnaire was Cronbach α = .70.

Mental well-being

Mental well-being was measured using the 14-item Korean Mental Health Continuum-Short Form (K-MCH-SF) adapted by Lim, Ko, and Shin, et al.[31] A higher total score indicates greater mental well-being. The reliability in the study was confirmed to be Cronbach α =.95.

General characteristics

The general characteristics included gender, age, occupation, region of residence, family type, experience with the Itaewon disaster, and changes in drinking behavior.

In particular, for the victimization experience of the Itaewon disaster, if participants responded that they were victimized, they were given 4 options to choose from: physical injury to self; physical injury to a family member, relative, or friend; death of a family member or friend; and witnessed the death or injury on the spot, and were categorized as direct exposure. Participants who indicated in the questionnaire that they were not directly affected were categorized as indirect exposure. Changes in drinking behavior after a disaster were categorized into changes in consumption and frequency, as described by Stevens, Shireman, and Steinley, et al.[32]

Ethical Considerations

This study was approved by the Ethics Committee of the C University (IRB number 1041078-20221129-HR-019). The researchers explained to the participants that the study was conducted with their consent, that the data would be used only for research purposes, and that anonymity and confidentiality would be maintained. Participants were also informed that they could withdraw from the study at any time and would not be penalized for doing so. Participants were provided with a small honorarium for their participation.

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Data Collection

Data were collected from May 2-9, 2023. A link was sent to each participant's mobile phone so they could connect online to respond to the questionnaire. The survey took approximately 15 minutes to complete.

Analysis

The collected data were analyzed using the IBM® SPSS® Statistics 26.0 statistical software package (IBM Corp. in Armonk, NY, USA), and R 3.4.2(R Foundation for Statistical Computing, Vienna, Austria), and statistical significance was set at $P < 0.05$. The general characteristics of participants were analyzed using descriptive statistics and frequency analysis. Mental health according to general characteristics was assessed using an independent *t*-test and ANOVA, and post hoc tests were performed using the Scheffe test. To compare the results of the first survey (Month 3 post-disaster) with this study (Month 6 post-disaster), a paired *t*-test was conducted, and a Pearson correlation analysis was conducted to determine whether there was a correlation between disaster victimization and mental health. Finally, for the multiple regression analysis of factors affecting mental health, PSM was performed using the R statistical software.

Results

The general characteristics of participants are presented in Table 1. Most participants were in their 20s (43.4%), and 69.3% were employed. Among the participants, 66.8% reported living in Seoul or the Seoul metropolitan area, where the Itaewon disaster occurred. The most common family type was living with a guardian (31.2%), followed by living alone (24.4%) and living with a partner and children (21.5%). Among the participants, 78.5% said they were not directly affected by the disaster, whereas 44 (21.5%) said they were. Of the 44 participants who reported being directly affected by the disaster, 68.2% reported physical injury to a family member, relative, or friend; followed by 15.9% who witnessed death or injury on the spot; 13.6% reported the death of a family member or friend; and 1 (2.3%) reported physical injury to themselves. In terms of changes in drinking behavior after a disaster, more than 70% reported no change in both frequency and consumption. Of those who reported a change, a slightly higher proportion reported an increase rather than a decrease.

The results of the analyses of anxiety, depression, and PTSD among participants according to their general characteristics are shown in Table 2. When we examined the differences in anxiety, depression, and PTSD according to the age of the participants, we found that anxiety was highest among those in their 40s and above, followed by depression and PTSD among those in their 30s, 40s, and 20s. Anxiety ($t = 6.688$, $P = 0.002$) and PTSD ($t = 6.799$, $P < 0.001$) were found to be significantly differed by age.

When analyzed by level of victimization, those who were victimized had mean scores that were more than twice as high as those who were not victimized, and all 3 cutoffs were problematic. For PTSD, those who reported being victimized had a mean score of 34.16, which was identified as high-risk. Significant differences were found in anxiety ($t = 5.734$, $P < 0.001$), depression ($t = 5.817$, $P < 0.001$), and PTSD ($t = 6.403$, $P < 0.001$). The results showed that victimization correlated with higher levels of anxiety, depression, and PTSD.

Table 1. General characteristics ($n = 205$)

Variables	Characteristics	*n* (%)
Gender	Male	65 (31.7%)
	Female	140 (68.3%)
Age	19–29	89 (43.4%)
	30–39	73 (35.6%)
	40 = <	43 (21.0%)
Occupation	Employed	142 (69.3%)
	Unemployed	4 (2.0%)
	Student	59 (28.8%)
Residence region	Seoul & Metropolitan	137 (66.8%)
	Others	68 (33.2%)
Family type	Living alone	50 (24.4%)
	Living with a partner	21 (10.2%)
	Living with a partner and children	44 (21.5%)
	Living with dependents	26 (12.7%)
	Living with guardian	64 (31.2%)
Experience as a victim of the Itaewon disaster	Yes	44 (21.5%)
	No	161 (78.5%)
Segmentation of experience as a victim ($n = 44$)	Physical injury to yourself	1 (2.3%)
	Physical injury to a family, relative, or friend	30 (68.2%)
	Death of a family or friend	6 (13.6%)
	Witnessed the death or injury on the spot	7 (15.9%)
Changes in drinking frequency after Itaewon disaster	Increased	31 (15.1%)
	No change	147 (71.7%)
	Decreased	27 (13.2%)
Changes in alcohol consumption after Itaewon disaster	Increased	29 (14.1%)
	No change	153 (74.6%)
	Decreased	23 (11.2%)

Depression, anxiety, and PTSD scores were higher in those who increased their drinking frequency after the disaster than in those who decreased their drinking frequency. In particular, the mean scores were more than twice as high for those who increased their drinking frequency as for those who did not. We also found that mean scores were higher for those who decreased their drinking frequency than for those who did not. Significant levels were found for anxiety ($t = 15.964$, $P < 0.001$), depression ($t = 11.307$, $P < 0.001$), and PTSD ($t = 13.310$, $P < 0.001$). Additionally, depression, anxiety, and PTSD scores were higher in participants who consumed alcohol after the disaster than in those who did not consume alcohol. In particular, participants who increased their drinking had mean scores more than twice as high as those who maintained their drinking levels, and increased drinking was associated with higher levels of anxiety, depression, and PTSD.

When analyzing mental health by family type, anxiety, depression, and PTSD were the highest among those living with a partner,

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Table 2. Differences in mental health factors according to general characteristics 6 months post-Itaewon crowd crush disaster (n = 205)

Variables		n (%)	Anxiety		Depression		PTSD	
			M ± SD	t or F(P)	M ± SD	t or F(P)	M ± SD	t or F(P)
Age	19–29[a]	89 (43.4%)	3.61 ± 3.62	6.688 (0.002) c>a	4.80 ± 5.40	1.523 (0.220)	16.24 ± 15.31	6.799 (0.001) c > a
	30–39[b]	73 (35.6%)	5.86 ± 4.07		6.23 ± 4.91		26.12 ± 18.43	
	40 = <[c]	43 (21.0%)	8.00 ± 4.38		5.51 ± 5.28		19.00 ± 8.63	
Experience as a victim from the Itaewon disaster	Yes	44 (21.5%)	7.59 ± 3.88	5.723 (0.000)	9.23 ± 4.19	5.817 (0.000)	34.16 ± 16.99	6.403 (0.000)
	No	161 (78.5%)	3.91 ± 3.74		4.43 ± 5.01		16.56 ± 15.92	
Changes in drinking frequency after Itaewon disaster	Increased[a]	31 (15.1%)	8.04 ± 3.52	15.964 (0.000) a > b	9.33 ± 5.75	11.307 (0.000) a > b	32.37 ± 17.16	13.310 (0.000) a,c > b
	No change[b]	147 (71.7%)	3.83 ± 3.71		4.54 ± 4.81		16.65 ± 15.98	
	Decreased[c]	27 (13.2%)	5.94 ± 4.35		6.45 ± 5.01		27.32 ± 19.41	
Changes in alcohol consumption after Itaewon disaster	Increased[a]	29 (14.1%)	8.57 ± 3.55	22.090 (0.000) a > b	11.00 ± 3.80	22.989 (0.000) a > c > b	38.26 ± 16.41	24.904 (0.000) a > b
	No change[b]	153 (74.6%)	3.74 ± 3.57		4.26 ± 4.82		15.96 ± 15.02	
	Decreased[c]	23 (11.2%)	6.72 ± 4.40		7.38 ± 4.85		29.21 ± 19.71	
Family type	Living alone[a]	50 (24.4%)	3.98 ± 3.67	3.696 (0.004) b > a,e	5.46 ± 5.98	2.398 (0.051)	16.60 ± 15.13	3.531 (0.008) b > a,e
	Living with a partner[b]	21 (10.2%)	7.33 ± 4.93		8.29 ± 6.23		33.00 ± 19.97	
	Living with a partner and children[c]	44 (21.5%)	5.39 ± 4.31		5.98 ± 5.05		20.73 ± 18.98	
	Living with dependents[d]	26 (12.7%)	5.04 ± 3.18		4.54 ± 4.48		20.12 ± 13.77	
	Living with guardian[e]	64 (31.2%)	3.80 ± 3.81		4.55 ± 4.32		18.92 ± 17.84	

The superscripts in the table indicate the results of post-hoc analyses for the mental health factors.

Table 3. Effects of general characteristics on mental health (n = 205)

Variables	Characteristics	Anxiety		Depression		PTSD	
		B(β)	t(P)	B(β)	t(P)	B(β)	t(P)
Age	19–29	1(ref)		1(ref)		1(ref)	
	30–39	1.913	4.426	1.569	2.951	9.753	5.235
		(0.225)	(< 0.001)	(0.153)	(0.003)	(0.274)	(< 0.001)
	40 = <	2.39	3.519	1.219	1.458	5.619	1.919
		(0.163)	(< 0.001)	(0.069)	(0.146)	(0.092)	(0.056)
Experience as a victim of the Itaewon disaster	No	1(ref)		1(ref)		1(ref)	
	Yes	2.311	5.872	2.104	4.343	11.023	6.496
		(0.283)	(< 0.001)	(0.213)	(< 0.001)	(0.322)	(< 0.001)
Changes in drinking frequency after Itaewon disaster	No change	1(ref)		1(ref)		1(ref)	
	change	0.143	0.256	1.043	1.519	3.154	1.311
		(0.015)	(0.798)	(0.092)	(0.130)	(0.08)	(0.191)
Changes in alcohol consumption after Itaewon disaster	No change	1(ref)		1(ref)		1(ref)	
	change	2.372	4.305	2.947	4.346	4.569	1.923
		(0.268)	(< 0.001)	(0.276)	(< 0.001)	(0.123)	(0.055)
Family type	Living alone	1(ref)		1(ref)		1(ref)	
	Living others	−0.71	1.174	−2.722	3.727	−2.394	0.919
		(−0.056)	(0.241)	(−0.182)	(< 0.001)	(−0.045)	(0.359)

followed by those living with a partner and children. Anxiety was the lowest among those living with a guardian, depression was the lowest among those living with dependents, and PTSD was the lowest among those living alone. Anxiety (t = 3.696, P = 0.004) and PTSD (t = 3.531, P = 0.008) were significantly different by household type, but depression was not found to be significantly different.

On the other hand, the results of the multiple regression analysis of the effects of general characteristics on mental health are shown

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Table 4. Comparison of mental health status after Itaewon crowd crush disaster over time (n = 205)

	Anxiety		Depression		PTSD		General mental health		Mental well-being	
Variables	M±SD	t or F(P)	M±SD	t or F(P)	M±SD	t or F(P)	M±SD	t or F(P)	M±SD	t or F(P)
3 months	4.58±4.01	–0.303 (0.762)	6.45±5.33	1.904 (0.058)	20.93±18.81	0.323 (0.747)	7.07±3.34	0.625 (0.533)	29.75±13.67	0.294 (0.769)
6 months	4.70±4.06		5.46±5.22		20.34±17.67		6.88±2.81		29.34±14.15	

*Data were extracted from a current survey of mental health 3 months after the Itaewon disaster by Choi, Um, and Cho (2023), which was conducted with the same participants as this study.

Table 5. Differences in mental health severity according to victimization type (n = 205)

Mental health factors according to severity distribution				Experienced as a victim from the Itaewon Disaster		
Variable	severity	Range	n(%)	Yes (n = 44)	No (n = 161)	$\chi^2(p)$
Anxiety (GAD7)	Normal	0–4	103 (50.2%)	11 (25.0%)	92 (57.1%)	22.399 (0.000)
	Mild	5–9	77 (37.6%)	20 (45.5%)	57 (35.4%)	
	Moderate	10–14	20 (9.8%)	11 (25.0%)	9 (5.6%)	
	Severe	15 = <	5 (2.4%)	2 (4.5%)	3 (1.9%)	
	Total	0–21	205 (100%)	44 (100%)	161 (100%)	
Depression (PHQ9)	Normal	0–4	109 (53.2%)	4 (9.1%)	105 (65.2%)	44.215 (0.000)
	Mild	5–9	52 (25.4%)	23 (52.3%)	29 (18.0%)	
	Moderate	10–19	41 (20.0%)	16 (36.4%)	25 (15.5%)	
	Severe	20 = <	3 (1.5%)	1 (2.3%)	2 (1.2%)	
	Total	0–27	205 (100%)	44 (100%)	161 (100%)	
PTSD (IES-R)	Normal	0–17	105 (51.2%)	6 (13.6%)	99 (61.5%)	41.244 (0.000)
	Risk	18–24	25 (12.2%)	4 (9.1%)	21 (13.0%)	
	High risk	25 = <	75 (36.6%)	34 (77.3%)	41 (25.5%)	
	Total	0–88	205 (100%)	44 (100%)	161 (100%)	

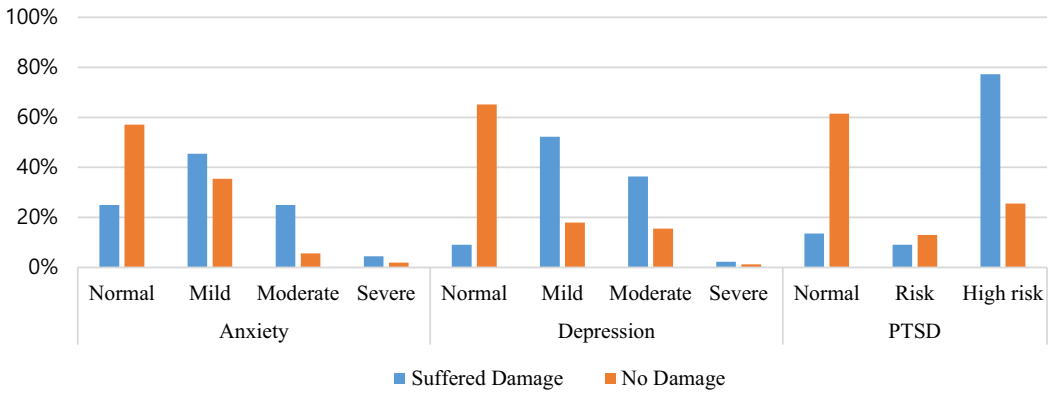

Figure 1. Differences in mental health severity of disaster.

in Table 3. Experience as a victim of the Itaewon disaster was found to have a significant effect on anxiety (β = 0.283, P < 0.001), depression (β = 0.213, P < 0.001), and PTSD (β = 0.322, P < 0.001). After the Itaewon tragedy, changes in the amount of alcohol consumed significantly affected anxiety (β = 0.268, P < 0.001) and depression (β = 0.276, P < 0.001). On the other hand, the frequency of drinking did not affect anxiety, depression, or PTSD. In terms of family type, only depression (β = −0.182, P < 0.001) had a significant effect in living with others compared to living alone.

A comparison of mental health status over time (Month 3 and Month 6 post-disaster) after the crowd crush incident is shown in Table 4. Anxiety, depression, PTSD, general mental health, and mental well-being showed decimal point differences in scores; however, these differences were not significant. Table 5 and

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Figure 1 show the severity of mental health problems according to whether they were affected by the Itaewon disaster. We found significant differences in the severity of depression ($P < 0.001$), anxiety ($P < 0.001$), and PTSD ($P < 0.001$) based on whether they were directly affected by the disaster. Among the catastrophe victims, 75% reported anxiety symptoms compared to 42.9% of non-victims. Regarding depression, 90.9% of victims reported at least moderate depression compared to 34.7% of non-victims. For PTSD, 77.3% of victims were identified as high-risk compared to 25.5% of non-victims.

Discussion

This study identified the extent of mental health problems experienced after the Itaewon disaster. It also analyzed changes in alcohol consumption due to the disaster, changes in mental health over time after the disaster, and differences in mental health by direct victim status to provide basic data on mental health after a mass man-made disaster. The main findings are as follows.

The results revealed differences in mental health based on general characteristics. Age was significantly associated with anxiety ($P = 0.002$) and PTSD ($P = 0.001$). Anxiety was highest in those in their 40s, depression and PTSD were highest in those in their 30s, and those in their 20s had relatively low scores on all 3 mental health indicators despite being the age group with the highest number of deaths. This is likely due to generational differences in mindsets. People in their 20s are more individualistic, and those in their 30s and 40s are more family oriented.[33] This means that although people in their 20s may be able to separate themselves from the event, people in their 30s and 40s may project anxiety onto their families. Those affected by the Itaewon disaster had significantly higher scores on anxiety ($P < 0.001$), depression ($P < 0.001$), and PTSD ($P < 0.001$) than those who were unaffected. This is similar to a study that examined the prevalence of PTSD in New Yorkers 6 months after the September 11, 2001, attacks, and found consistently higher results in those directly affected.[34] This suggests that psychological trauma persists across various forms of man-made disasters. Therefore, mid- to long-term psychological support interventions are needed that are not specific to a particular disaster but are adaptable to a wide range of man-made disasters. These results may also provide valuable data for predicting and preparing for patterns of psychological trauma in future man-made disasters

In this study, we found significant differences in anxiety ($P < 0.001$), depression ($P < 0.001$), and PTSD ($P < 0.001$) according to changes in drinking frequency and amount, confirming a relationship between mental health and drinking behavior. Post-traumatic experiences can lead to changes in drinking behavior, most often associated with increased drinking behavior.[35,36] In addition, prior research[12] indicating that exposure to man-made disasters increases the risk of alcohol use disorders supports the finding in this study that those who reported an increase in drinking after the Itaewon disaster were the most vulnerable to mental health conditions. However, a change in drinking behavior can also result in a decrease. In this study, those who decreased their drinking behavior were at a higher risk of developing PTSD, in addition to having poorer mental health. Therefore, it is worth revisiting the circumstances of the Itaewon disaster. The Itaewon disaster was negatively framed as a *nightlife accident* because it occurred during Halloween festivities. In a Korean Gallup survey conducted approximately a week after the disaster, when asked, "Who is primarily responsible for the disaster?" 14% of 1006 respondents said, "the people who went there."[37] The Itaewon disaster created a negative perception of drinking and nightlife, along with trauma. However, among individuals with PTSD, drinking has been shown to decrease in association with dysphoria or brain damage.[38,39] Therefore, it is possible that drinking behavior in the present study was reduced because drinking reminded them of the negative memories of the disaster. These differences in drinking behavior suggest that mental health and drinking behavior need to be examined in parallel and that psychological support for victims of disasters should include preventive measures against alcohol abuse disorder.

There were significant differences in anxiety ($P = 0.004$) and PTSD ($P = 0.008$) according to family type. In particular, we found that living alone had a relatively good state, with the lowest scores on all measures of mental health, compared to other family types. This differs from previous studies that found living alone to be a risk factor for trauma and depression.[40,41] To understand these results, it is necessary to relate these findings to age. In this study, those living alone accounted for 24.4% ($n = 50$), the highest proportion of household types, and people in their 20s accounted for 43.4% ($n = 89$), the highest proportion of age distribution. This indicates that the majority of people living alone were in their 20s. Therefore, this finding could be interpreted as an anomaly that reflects the mental health characteristics of people in their 20s, which are relatively poor compared to other age groups. Family is an important support system that influences recognition and recovery from trauma.[42] However, in this study, those living with a supportive partner, rather than living alone, were the most vulnerable across all mental health domains. People are "walking mood inductors who trigger a ripple effect of emotions through their interactions."[43] In particular, living with partners is more interdependent than other types of dyads, as partners share significant amounts of time with each other, and 1 study confirmed that the partner's depression level affects the partner's depression level in actual old age dyads.[44] Based on the ripple effect of these moods, the results suggest that negative sentiments among family members may be influenced by continuous media contact.

Findings from the Month 3 survey conducted 100 days after the Itaewon disaster, and the Month 6 survey, confirmed that the levels of psychological trauma were maintained, with no significant changes in anxiety, depression, PTSD, general mental health, or well-being. In particular, the proportions of participants at high risk and at risk for PTSD were similar at 47.3% (3 months) and 48.7% (6 months), respectively. This is contrary to previous studies that showed improvements in anxiety, depression, and PTSD approximately 2 months after a disaster,[45,46] but similar to previous studies that showed that the psychological trauma of disasters lasts for more than a year without treatment.[47,48] In the case of the Itaewon disaster—as the specific cause of the disaster has not yet been determined, nor have the responsible individuals been identified and punished—may have had an impact on long-term psychological trauma of those with direct and indirect exposure to the crowd crush disaster.

Our study's results showed significant differences in the severity of anxiety, depression, and PTSD based on the type of experiences related to the Itaewon disaster. This is consistent with previous studies on the Pohang earthquake in South Korea,[49] the Great East Japan Earthquake[50], and Lim and Shim.[51] Whereas previous studies focused on natural disasters, the Itaewon crowd crush was a man-made disaster, and it was also a traumatic event with force majeure characteristics and psychological impacts, such as anxiety, depression, and PTSD, which occurred due to victims' direct

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exposure to the disaster. In Park's[52] study, 80.8% of disaster victims complained of psychological damage, and over 40% of them were at a high risk of PTSD, which is similar to the results of this study, in which 36.6% of the victims were at a high risk of PTSD. Additionally, those who were not directly affected by the disaster were also found to experience negative psychological effects, with 13% at risk and 25.5% at high risk for PTSD. This supports the findings of Lee, Choi, and Lee, et al.[46] and Chung, Chung, and Man, et al.,[53] suggesting that contact with a disaster, such as through news and social media, can increase PTSD, even if one does not experience it directly. In line with previous studies by the World Health Organization[54] showing that even if a person does not directly experience a disaster, just being aware of the disaster increases anxiety and fear, our study found that more than 30% of the participants who did not experience a disaster complained of anxiety and depression, which can be seen as a consequence of indirect exposure to disaster. In the case of the Itaewon crowd crush disaster, which occurred on a specific day, people in their 20s and 30s accounted for most of the deaths, making it easy for indirect victims to be exposed to psychological trauma as the disaster situation was revealed on social media in real time. Based on these results, immediate intervention for the psychological trauma experienced by victims, such as those of the Itaewon crowd crush disaster, is critical, and guidelines that provide psychological support to indirect victims after a social disaster are necessary. Furthermore, as negative emotions generated after a disaster can be easily transmitted and assimilated by others, it is necessary to provide social alternatives to overcome them.[46]

This study contributes to the literature on disasters and mental health by providing foundational data on the psychological impact of the Itaewon disaster. It reveals that psychological trauma is not only widespread among those directly affected but also significantly present in individuals indirectly exposed to the event, with these effects persisting even 6 months later. This underscores the urgency of ongoing monitoring and management of psychological trauma, extending beyond immediate victims to include those indirectly impacted. Developing targeted support measures, such as broadening the scope of recipients, is crucial.

Conclusion

The results showed differences in anxiety, depression, and PTSD based on whether participants had directly or indirectly experienced a disaster. Participants who changed their drinking behavior had higher scores and significant differences in anxiety, depression, and PTSD compared with those who did not change their drinking behavior, confirming the link between changes in drinking behavior and post-disaster mental health. Participants who reported negative mental health indicators at the Month 3 post-disaster survey were not significantly different from those at the Month 6 post-disaster survey, indicating that they still reported negative mental health indicators. In particular, the proportions of those at risk for PTSD were similar at 47.3% (3 months) and 48.7% (6 months), suggesting the need for appropriate treatment. Regarding the severity of anxiety, depression, and PTSD according to their direct or indirect experience of the disaster, participants who experienced the disaster directly had higher severity. However, 20% of the participants who did not directly experience the disaster were at high risk of developing PTSD, confirming the possibility of indirect trauma. This study aims to understand the extent of psychological trauma following disasters and the scope of interventions.

4.1. Limitations

This study had several limitations. First, this study was conducted by re-surveying the participants who responded to the first Month 3 post-Itaewon crowd crush disaster survey at Month 6 post-disaster. Therefore, the sample was not diverse, which limits the generalization of mental health status by victim status. Additionally, there may be limitations to the validity of the responses, such as sample bias, volunteer bias, and the authors' inability to determine whether the respondent was actually harmed. Future studies should include a larger, more representative sample size to ensure generalizability and provide additional measures, such as self-report cross-validation, to validate respondents' experiences and increase reliability. Second, all variables in this study were measured using online surveys with self-report scales. Measures of mental health, such as anxiety, depression, and especially PTSD, should be combined with structured clinical interviews, and not just simple scales, to obtain more in-depth results. Particularly, the psychological distress of victims and survivors requires a more nuanced approach. Finally, as abnormal mental health findings were also identified in participants who did not directly experience the disaster in this study, it is necessary to understand indirect trauma and identify the processes and characteristics of indirect trauma. We also suggest the use of prospective longitudinal research designs to identify changes in mental health after disasters.

Data Availability. Due to the nature of the research, data is not available for ethical reasons.

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Author contribution. All authors made significant contributions to the paper. Choi, Song, Namgung, and Lee conceptualized and designed the study. Data investigation and curation were conducted by Namgung and Lee, and results were analyzed by Choi and Song. Song, Namgung, and Lee prepared the first draft of the manuscript, and Choi reviewed and edited the manuscript. All authors have read and approved the final version for submission.

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